Report

on

TECHNICAL ALFALFA CONFERENCE

Western Regional Research Laboratory

Albany, California

April 15, 1953

Co-sponsored by

Bureau of Agricultural and Industrial Chemistry,

Agricultural Research Administration,

U. S. Department of Agriculture

and

American Dehydrators Association

PROGRAM

Convene - 9:30 a.m.

Introductory Remarks, M. J. Copley, Director, Western Reg. Res. Lab.

Research

H. G. Moeller, Sioux Alfalfa Meal Co., Vermillion, South Dakota - Presiding.

"Xanthophylls in Poultry Feeds--Alfalfa as a Source" - H. R. Halloran, Laboratory Directory, Poultry Producers of Central California, Petaluma, California.

"Alfalfa in Poultry Rations" - H. J. Almquist, Director of Research, The Grange Co., Modesto, California.

"Alfalfa in Swine and Cattle Rations" - L. E. Card, Head of Animal Science Dept., University of Illinois, Urbana, Illinois.

"Composition of Alfalfa--Its Relation to the Production of Improved Feeds" - W. D. Maclay, Head of Field Crop Utilization Division, Western Reg. Res. Lab.

"Carotene Determination--Sources of Possible Error" - C. R. Thompson, Alfalfa Section, Western Reg. Res. Lab.

Reconvene - 2:00 p.m.

Alfalfa Processing

J. Fielder, Dixon Dryer Co., Dixon, Calif. - Presiding.

"Field Harvesting" - Ray E. Bert, Bert and Wetta, Maize, Kansas

"The Dehydrator" - V. C. Britton, V. C. Britton Co., Firebaugh, Calif.

"Oiling Alfalfa Meal" - G. R. Van Atta, Alfalfa Section, Western Reg. Res. Lab.

"Pelleting Alfalfa Meal" - A. Alessio, California Pellet Mill Co., San Francisco, California.

Discussion.

Introductory Remarks, M. J. Copley

The conference was brought to order by Dr. M. J. Copley. After extending a cordial welcome to those attending, Dr. Copley briefly reviewed the general aspects of the research program of the Laboratory since its occupancy in 1940. He then sketched the development and present status of the alfalfa research program in somewhat greater detail. His remarks regarding various aspects of the work aimed at developing practical measures for preservation of carotene in dry alfalfa during storage included mention of the investigation of field preprocessing methods now being conducted under contract with the Arizona Agricultural Experiment Station.

In discussing investigation of those minor constituents of alfalfa which are as yet largely unidentified, Dr. Copley referred to alfalfa saponin as an example from this group of little known substances pointing out its probable role as a chick-growth inhibitor under some conditions and its possible function as a causative agent in ruminant bloat. In connection with this subject Dr. Copley told the group of the alfalfa saponin-feeding tests being conducted by Dr. Burt Heywang at the Arizona Poultry Experiment Station in Glendale, Arizona, in cooperation with the Western Regional Research Laboratory.

Dr. Copley also spoke briefly about the work in progress on the identification and estimation of xanthophylls in alfalfa and mentioned the contract between the Department and the National Research Council in which the latter will compile the most reliable data available on the composition of domestic forages, including alfalfa.

Research

H. G. Moeller - Presiding

"Xanthophylls in Poultry Feeds" -- H. R. Halloran.

Basically there are two pigmentary problems in feeding poultry. The first one is related to supplying the breeding hen adequate pigment in order that the chicks produced may have acceptable color. Any differences in color in newly hatched chicks is evident in the shanks of the birds. Chicks with pale shanks are not as acceptable to the poultryman even though they could be produced from eggs laid by hens fed in nutritionally complete diet.

The second problem is related to the color of meat birds. The San Francisco poultry market has been based on a consumer acceptance of a "milk fed chicken." Such a bird is light in color. In the past few years there has been a limited demand for a more highly pigmented bird, the preference ranging from a light yellow to a very highly colored chicken. One of our poultryman has developed a market for a Cornish-New Hampshire Cross which has skin, shanks, and fat of deep yellow color.

The amount of color is definitely affected by the fat deposition. Most of the birds marketed by this poultryman are hormone treated for three or four weeks

before marketing. The use of the diethyl stilbestrol treatment seems to drain out the color from the bird and extra pigment is required if a definite yellow color is desired. If the consumers want colored poultry, the pigmentation of the dressed birds is of direct economic importance to the meat-bird raiser. This is especially true when a surplus of poultry is available. Some buyers will deduct one or two cents a pound if the birds are not well pigmented.

At the Texas Nutrition Conference last October, Dr. Francis Bird of the Eastern States Farmers Exchange gave a paper on pigmentation. He emphasized the effect of breeding on the yellow color of poultry and told of an experience at the 1952 Connecticut Chicken of Tomorrow Contest. "One entry of Barred Plymouth Rocks, a strain not bred for meat production, was practically devoid of color. The winning entry, a White Plymouth Rock was well pigmented and very uniform in color. In other entries there were marked variations in pigmentation within the same strain of chickens fed the same feed." Dr. Bird also pointed out that pullets do not carry as much pigment as do cockerels.

Certain diseases will drain the color from meat birds very rapidly. The decolorizing effect of coccidiosis is well known. The respiratory diseases also result in a rapid loss of color. Dr. Francis Bird mentioned in his talk at the Texas Nutrition Conference that the Connecticut workers had told him that in chronic respiratory disease (or air sac) a loss of color is one of the early symptoms. Diseases probably result in more pigment loss than any other single factor. The birds can generally regain their color if they receive a high energy ration containing adequate quantities of dehydrated alfalfa meal for a period of two or three weeks after recovery.

Most modern fryer and broiler rations contain ample pigmenting factors for a normal yellow color. The complaints received by feed manufacturers can usually be traced to an attack of one or more diseases. Many times the visual symptoms are not obvious enough to indicate that the birds are sick. In most of the disease cases, the feeds are unjustly blamed.

In order that there be color in birds which have the ability to deposit pigments and which have had no outbreak of disease, there still has to be a source of the yellow pigment. The yellow color in the skin, shanks, and fat consists of a group of pigments called xanthophylls. There are many fractions in this group and of course more research work is needed in order to verify the pigmentary effect of the different types. It is known, however, that certain of the xanthophylls result in the yellow color in chickens. These xanthophylls are related chemically to carotene. There is approximately twice as much xanthophyll as carotene in alfalfa.

Certain feed ingredients evidently have pigment-suppressing factors. These materials are milk, mineral oils, fish oils (especially fortified cod liver oils), fish meal, meat scrap, bone meal, and soybean meal. From this formidable list it can be seen that it would be difficult to formulate a practical ration nowadays without using substantial quantities of several of these ingredients. Therefore, it is important to make use of the pigment-developing feedstuffs. These are dehydrated alfalfa meal, ground yellow corn, some types of corn gluten meal, and xanthophyll concentrates (produced from alfalfa and corn).

Most xanthophyll concentrates are available in oil form and also are premixed by supplement manufacturers on dry carriers.

Table I shows the xanthophyll and carotene analyses of various feed ingredients. Dehydrated alfalfa meal is obviously an excellent source of "color" factors. Table II shows the xanthophyll and carotene contents of some of the xanthophyll concentrates. The variations in xanthophyll concentration are primarily due to differences in dilution with vegetable oils. Some of the concentrates are quite viscous and are difficult to handle in premixing. The variations in the carotene-xanthophyll ratios are due to differences in methods of production.

Table III shows comparisons of carotene and xanthophyll stabilities. These results are part of the work on the use of an antioxidant on dehydrated alfalfa meal. The xanthophyll stabilities differ from those given by Drs. Thompson and Maclay, primarily because of a difference in the method of assay. On the basis of the xanthophyll method used in our laboratory, xanthophyll and carotene have similar stabilities. Another xanthophyll method indicates xanthophyll is somewhat more stable than carotene.

Table IV shows the method of color evaluation for chickens on feeding trials. The color score of 2.0 is considered a normal yellow color, and a color score of 3.0 a deep yellow color. The birds involved in feeding trials shown in Tables V, VI, and VII were scored on this basis for their acceptance by consumers wanting color in poultry. Table V shows the results of a trial wherein Cornish-New Hampshire Crosses (males and females) were hormone treated at 7 weeks of age and fed the indicated diet for 4 weeks. Therefore, at 11 weeks of age these birds were marketed, and were then graded. The high energy broiler ration with 2% dehydrated alfalfa resulted in a good yellow color in the shanks and skin of the birds. An additional 10% alfalfa in the high energy broiler ration resulted in a deeper yellow color. The addition of a xanthophyll concentrate resulted in a higher color score. The feeding of a medium energy broiler mash with a higher percentage of alfalfa gave a normal yellow color. The feeding of a laying mash with 12% alfalfa resulted in a lighter color, indicating the effect of a different combination of ingredients. This corroborates previous work reviewed by Dr. Francis Bird in his Texas talk.

Table VI shows the results of a feeding trial wherein the Cornish-New Hampshire Crosses (male & female) were hormone treated at 10 weeks of age and fed the indicated diets until they were marketed at 14 weeks. On the special broiler finisher, the additional xanthophyll (more than 5 times as much) had no further pigmentary effect.

Table VII shows the color score on chickens marketed at 8 weeks of age. These did not have any hormone treatment. The Cornish-New Hampshire Crosses (which were from a different breeder) had approximately the same color scores on the 3 rations listed. The New Hampshires used in the test did not have as good color when fed the medium energy ration as when fed a high energy ration. The same trend was noted in the Leghorn cockerels. All birds had excellent yellow color without the necessity of added xanthophyll supplement.

The following conclusions may be made from these investigations:

(1) The type of ration and its ingredients affect the pigmentation more than the percent of alfalfa in the formula.

(2) In the high energy broiler ration tested, increasing the dehydrated alfalfa meal resulted in greater pigmentation.

(3) The breeding influences color response.

(4) The xanthophyll concentrate used resulted in increased pigmentation.

(5) All the broiler rations tested showed from good to excellent yellow color.

There are three practical points which the feed manufacturer should consider. The first, to provide education on the role of breeding and disease affecting pigmentation. The second, to give careful consideration to the formulation of feeds which will help in maximum pigmentation, keeping in mind the pigment-suppressing ingredients and the pigment-developing materials. The third consideration is the choice of proper sources of the ingredients selected, which would be covered under a quality-control program.

The alfalfa dehydrator has two primary purposes. The first is to maintain production conditions conducive to maximum retention of xanthophyll in the meal. The second is to inform the feed manufacturers of this plus value of dehydrated alfalfa meal. Breeder and broiler rations containing pigment-rich alfalfa produce attractive, well-colored chicks and meat birds.

Table I

Carotene and Xanthophyll Analyses of Several Ingredients

Material	Carotene PPM	Xanthophylls PPM
Dehydrated Alfalfa Meal #1	284	630
Dehydrated Alfalfa Meal #2	258	475
Dehydrated Alfalfa Meal #3	160	386
Dehydrated Alfalfa Meal #4	311	755
Ground Yellow Corn #1	---	3
Ground Yellow Corn #2	---	5
Ground Milo	---	0
Corn Gluten Meal #1	8	44
Corn Gluten Meal #2	3	20

Table II.

Carotene and Xanthophyll Analyses of Several Commercial Xanthophyll Concentrates

Supplier	Carotene Grams/Lb.	Xanthophylls Grams/Lb.
#1	1.7	1.4
#2	1.4	1.9
#3	1.9	2.9
#4	0.22	0.67
#5	1.1	1.1

Table III.

Comparisons of Carotene and Xanthophyll Stabilities in Dehydrated Alfalfa Meal

	Percent Loss After 6 Months Storage	
	Carotene	Xanthophylls
Dehydrated Alfalfa Meal	41%	38%
Dehydrated Alfalfa Meal with Antioxidant	19%	19%

Table IV.

Method of Color Evaluation

Score	Description
0	No yellow color.
1	Light yellow color.
2	Normal yellow color.
3	Deep yellow color.
4	Yellow-orange color.

Table V.

Chick Feeding Trial (4-51)

Hormone Treated 7 Week Cornish-New Hampshire Crossed (Male & Female) Fed Indicated Diets for Four Weeks

Type of Feed	Supplement	Total % Dehy. Alfalfa Meal	Color Score
High Energy Broiler Mash	None	2%	2.4
High Energy Broiler Mash	10% Alfalfa	12%	2.8
High Energy Broiler Mash	64 grams of xanthophylls per ton of feed.	2%	3.5
Medium Energy Broiler Mash	None	4%	2.0
Laying Mash	None	12%	1.5

Table VI.

Chick Feeding Trial (5-51)

Hormone Treated 10 Week Cornish-New Hampshire Crosses (Male & Female) Fed Indicated Diets for Four Weeks

Type of Broiler Mash	Xanthophyll Supplement	Total % Dehy. Alfalfa Meal	Color Score
	Grams of Xanthophylls/ton feed.		
High Energy	None	3	2.5
High Energy	3	3	2.6
High Energy	8	3	2.9
Special Finisher	3	5	3.0
Special Finisher	16	5	3.0

Table VII

Chick Feeding Trial (3-51)

8 Week Old Chickens on 3 Different Breeds

Type of Broiler Feed	% Dehydrated Alfalfa Meal	*Crosses (Breeder B)	*New Hampshires	Leghorn (Cockerels)
Medium Energy	4%	3.0	2.4	2.5
High Energy	2%	2.9	3.0	2.8
High Energy	3%	2.9	3.0	2.8

* Male & Female.

The most pertinent new point made in the discussion that followed presentation of Mr. Halloran's paper was offered by Dr. A. A. Klose of the Poultry Division of this Laboratory. He remarked that high temperature scalding as now practiced in poultry dressing plants for the sake of high rates of production causes the removal of a heavily pigmented outer skin layer and thus reduces the color of the dressed carcasses more than did the older, low temperature scalding.

"Dehydrated Alfalfa Meal in Poultry Rations" -- H. J. Almquist.

What I have to say on this subject is based primarily on my own experience and observations. It would be well, first, to consider what is known about the nutritive value of dehydrated alfalfa meal in poultry feeding.

At levels of meal normally used, the protein of alfalfa is not a large part of the total protein in the poultry diet. However, it is of interest to examine the amino acid makeup of alfalfa protein in relation to poultry requirements. I have for years collected all amino acid analyses reported on feedstuff proteins. Taking what appears to be the best average of these reports on alfalfa amino acids, I obtain the following figures:

Amino acid analysis of alfalfa protein and comparative requirements of fowls.

Amino Acid	Percentage of amino acid in crude protein.			
	Alfalfa Meal	Diet of Young Chick	Diet of Young Poult	Diet of Laying Hen
Arginine	4.6	6.0	5.7	
Histidine	1.6	0.8		
Lysine	5.2	4.5	5.4	3.3
Methionine	1.4	2.3	2.0	1.9
Cystine	2.0	1.8	1.3	1.7
Tryptophan	1.2	1.0	0.9	1.0
Phenylalanine	4.2	4.5		
Tyrosine	3.1	3.5		
Leucine	6.3	7.0		0.9
Isoleucine	4.4	3.0	3.0	
Threonine	3.3	3.0		
Valine	5.2	4.0		

The last three columns represent approximately what is known about the amino acid requirements of the kinds of poultry indicated. It is evident that alfalfa protein is a fairly well balanced source of amino acids for poultry, but may require reinforcement to some extent in respect to methionine and possibly one or two other amino acids.

It has been reported that chicks and rats do not grow well if receiving only alfalfa as a source of protein in the diet. This is not surprising because we know that alfalfa meal as the principal item of diet would make a feed much too bulky and high in fiber for good results with these small omnivorous animals. On the other hand, we know that some types of animals can grow well

and utilize alfalfa protein efficiently when receiving no other source of protein but alfalfa meal. Since the amino acid requirements of warm-blooded, non-ruminating animals are quite similar, this fact is further proof of the relative completeness of alfalfa proteins.

If we may judge from available data on digestibility trials, and these are the only information we have to bear on the subject, other crude fractions of alfalfa meal, that is, fat, fiber and carbohydrates, are not highly available to poultry. If all indigestible components are added up we find that an alfalfa meal of about 17% crude fiber apparently contains total indigestible material equal to about 44% of the meal, while a 27% fi er meal contains about 59% total indigestible material. However, it is not necessary to be too much concerned about this content of indigestible material, as there is definite room for a certain amount of it in a modern poultry ration.

We are well aware of the fact that some samples of alfalfa meal have shown evidence of a growth inhibitor which becomes noticeably effective at relatively high levels of meal. I still feel, however, that the total indigestible material in alfalfa meal is the prime factor which curtails growth and efficiency of feed utilization when too much alfalfa meal is fed. Such material makes a voluminous and bulky feed which is hard for the bird to eat in a sufficient quantity. This is an effect separate from the effect of excessive bulk in the digestive tract. Under conditions of crowding and competition for feeding space, chickens have difficulty in gaining sufficient time to eat enough to meet daily requirements. That this is a real factor is shown when these bulky feeds are compressed into pellets. Then the birds are able to eat more rapidly and grow faster although the efficiency of the feed may not be particularly improved.

Alfalfa meal is an important source of vitamins especially of carotene, which is efficiently converted by the bird into vitamin A. In the case of feeds manufactured by our company, we depend entirely upon dehydrated alfalfa meal as the supplementary vitamin A source. We determine the carotene content of all alfalfa meal used. We have repeatedly checked the blood levels of vitamin A of birds on our feeds to be certain that they are converting the carotene into vitamin A effectively.

In addition to carotene, dehydrated alfalfa meal is an appreciable source of other vitamins of concern in practical poultry feeding such as indicated in the following values taken from my own tables.

	Miligrams per lb.
Choline	500
Niacin	18.
Riboflavin	7
Pantothenic Acid	16
Pyridoxine	6
Folic Acid	5
Vitamin B_{12}	.018 to .014
Vitamin E	100 -- 170
Vitamin K	+

There are repeated reports of unknown growth factors in alfalfa meal but these have not yet been chased out into the light so that they are clearly evident as separate new factors.

During the past few years, the poultry feed industry has gone through a period of reducing alfalfa meal down to 2, 1. 1/2 percent of the ration or even nothing. This reduction was caused by undue panic following reports of a growth inhibitor in alfalfa meal. At about the same time, "high-energy" or low-fiber feeds became the vogue and such fibrous products as alfalfa meal were throuwn out of the formulas. As a result of this trend there began to appear such previously unknown conditions as vitamin K deficiency in birds on commercial feeds. Now we are witnessing a decided swing back in the usage of dehydrated alfalfa meal.

During this phase, The Grange Company did not follow suit and did not curtail usage of dehydrated alfalfa meal in poultry feeds. This action was based upon repeated experimental tests of dehydrated alfalfa meal in poultry feeds under practical grower conditions and with sufficiently large numbers of birds. We already had feeds of the type currently called "high-energy" formulas, and have been making such for over 4 years. I may list a few results with alfalfa below as examples of our tests.

<u>May 1949. 1000 Rock/Hamp cross broilers per group.</u>

Dehydrated Alfalfa Meal in Diet	Weights at 11 Wks. Age	Feed Conversion	Fiber Level
4.5%	3.34 lbs	2.75	3.6
6.8	3.39	2.75	4.0

<u>June, 1949. 900 Rock/Hamp cross broilers per group.</u>

Dehydrated Alfalfa Meal in Diet	Weights at 11 Wks. Age	Feed Conversion	Fiber Level
4.5%	2.93	2.58	3.6%
6.8	2.92	2.58	4.0

<u>June, 1950. 900 Rock/Hamp broilers per group.</u>

Dehydrated Alfalfa Meal in Diet	Weights at 6 wks. Age	Feed Conversion	Fiber Level
3.7%	1.17 lbs	2.28	3.5%
4.9	1.16	2.35	3.7
6.2	1.14	2.31	4.0
7.4	1.13	2.29	4.4

On the basis of these and other tests we knew years ago that there was no advantage in reducing alfalfa meal levels. The optimal fiber level for

broilers on our feeds is near 4%. On either side of this fiber level, the growth results fall off. This finding is not in agreement with some notions elsewhere that the less fiber, the better the feed.

February, 1951. 400 Beltsville Small White poults per pen, 12 weeks age

Dehydrated Alfalfa Meal in Mash	Average Gain During Test.	Feed Conversion	Fiber Level
12.2%	3.22 lbs	5.17	6.1
14.7%	3.37 lbs	5.21	6.6
17.1%	2.98 lbs	5.67	7.1

These turkeys utilized the dehydrated alfalfa meal effectively up to 15% of the mash. More than this amount seemed to be too much, as the results at higher levels than 15% were evidently not as good. Actually we do not use levels that high, since it is necessary to leave some leeway in the feed for the variation of other feed ingredients.

In response to questions submitted after his paper Dr. Almquist offered the following additional comments:

Lowering alfalfa contents of poultry diets below adequate levels leads to disorders such as blowouts, cannibalism, etc.

It is difficult, in view of relative prices to reduce the cost of a feed by substituting another ingredient for alfalfa. Furthermore, comparison of feed costs should be made on the basis of comparative net returns which in turn requires consideration of all related cost items such as, for example, flock mortality.

"Dehydrated Alfalfa in Cattle and Swine Rations" -- L. E. Card.

The value of dehydrated alfalfa in rations for cattle and swine is an approrpiate topic for discussion at this conference because of the increased attention it is receiving from both nutrition workers and feeders of livestock. The dehydrated product is not often used as a replacement for alfalfa hay or other roughage in practical rations. But when it is used we must remember that alfalfa meal can be no better as a ration ingredient than the fresh cropfrom which it is made.

The common trade practice of blending is clearly a recognition of, as well as an attempt to offset, the wide variation in composition in order to supply feed manufacturers with a uniform product. Dehydrators must therefore be interested not only in the many values inherent in alfalfa, but also in methods by which those values can be retained in the product they sell.

There are many reports in the literature that emphasize the relation of the chemical composition of alfalfa to results obtained in the feed lot. One of

the most recent is from the California Agricultural Experiment Station. Beef cattle were fed alfalfa hay from two different fields. In a 91-day trial, cattle fed hay from a field that was well supplied with phosphorus gained 2.2 pounds per head per day, while similar cattle fed hay that was low in phosphorus gained only 0.5 pounds per head per day.

It is true that phosphorus can easily be supplied in other ways, but my point is that alfalfa is not necessarily a top-quality feed ingredient just because it is green or is put up in an attractive bag. We need to study all of the ways by which the raw material can be improved in nutritive value, as well as the processing methods by which the original value of fresh alfalfa can be retained until the dehydrated product is fed.

What, then, are the values inherent in high-quality alfalfa, and why is it fed to cattle or swine? We can probably agree on four nutritional values: protein; minerals, especially calcium and phosphorus; carotene; and water-soluble vitamins-- the latter two less important for cattle than for swine. There is a fifth value, not quite so clearly defined but perhaps just as important, namely, unknown or unidentified factors that up to the present time can be demonstrated only by the effects they produce. I should like to discuss each of these five values briefly and to mention some experiments that bring out their significance in the feeding of cattle and swine.

Protein

A test at the Nebraska Station compared dehydrated alfalfa pellets with chopped alfalfa hay, cured in three different ways, as sources of protein for wintering steer calves. The results are shown in the following table:

Nebraska Cattle Progress Report 193

Good to choice 452-pound Hereford steer calves, 13 per lot, were wintered (November to April - 146 days) on a full feed of August-cut prairie hay, two pounds per head daily of ground shelled corn and the following amounts per head daily of alfalfa to provide equivalent amounts of supplemental protein:

Lot No.	1	2	3	4
		(pounds)		
Warm-air-dried, chopped alfalfa hay	2.68	--	---	----
Fresh-air-dried, chopped alfalfa hay	---	2.61	---	----
Field-dried, chopped alfalfa hay	---	---	2.61	---
Dehydrated alfalfa pellets	---	---	---	2.30
Average daily gain	.94	1.02	.98	.98

In another test at Nebraska, dehydrated alfalfa meal was compared directly with soybean meal as a protein supplement for 675-pound yearling steers. Excellent gains were obtained with alfalfa, even though it must be admitted that 3.0 pounds of alfalfa meal per head daily will usually cost more than the amount of soybean meal (1.5 pounds) necessary to supply an equivalent amount of protein.

Nebraska Cattle Progress Report 190

Good to choice 675-pound Hereford yearling steers, 10 per lot, were fed for 140 days from May to October. Full-fed corn silage and ground ear corn, with 0.1 pound of steamed bone meal per head daily. Free access to salt and water. All protein supplements pelleted and fed on an equivalent nitrogen basis.

Lot No.	1	2	3	4
		(pounds)		
Supplement:				
Soybean meal	1.5	1.0	0.5	--
Dehydrated alfalfa meal	--	1.0	2.0	3.0
Average daily gain	2.32	2.52	2.62	2.71
Carcass yield, percent of selling weight	61.6	63.7	60.8	62.5

The Ohio Station, in a test with 630-pound steers, obtained gains from poor quality hay supplemented with dehydrated alfalfa meal that were distinctly better than gains from the same hay fed with soybean meal and nearly as good as those from good hay and soybean meal. Again, however, the cost of 100 pounds of gain was higher when alfalfa was fed.

Ohio Agricultural Experiment Station

Protein Supplements for Good and Poor Quality Hay

630-pound steers, 10 per lot, were full-fed corn and cob meal and either good or poor quality hay, with minerals, free choice and the supplements indicated (October to July, 259 days).

Lot No.	1	4	8
		(pounds)	
Soy bean meal	1.5	--	1.5
Hay	Good	Poor	Poor
Dehydrated alfalfa meal	---	3.6	---
Average daily gain	1.94	1.85	1.60
Dressing percentage	63.0	61.4	60.0
Feed cost per 100 lb. gain	$21.99	$26.51	$23.14

Soybean meal (solvent)	$80
Dehydrated alfalfa meal	80
Good hay	25
Poor hay	15

Minerals

Alfalfa is an excellent source of calcium and a fair source of phosphorus for cattle. The graph shown on page 15, adapted from one prepared by Dr. Bohstedt of the University of Wisconsin, shows how alfalfa compares with other common roughages in this respect.The diagonal lines indicate the range in calcium and phosphorus levels for cattle recommended by the National Research Council.

Calcium needs are well supplied if alfalfa makes up a fair percentage of the total feed intake, but additional phosphorus from other sources, such as soybean meal, linseed meal or cottonseed meal is necessary.

The protein concentrates of plant origin, including alfalfa meal, do not contain enough calcium to meet the needs of swine, and a simple mineral mixture is therefore an essential part of their ration.

Fat-Soluble Vitamins

The value of alfalfa meal for swine depends not only on the protein that it furnishes, but also on its content of carotene as a source of vitamin A. Dehydrated alfalfa meal has long been recognized as an excellent source of carotene, and there is no need to discuss that subject here. Vitamin A deficiency is no problem in cattle feeding in many parts of the country, but under conditions that are borderline or below, alfalfa is often the most practical means of preventing deficiency symptons.

As a source of vitamin D, dehydrated meal cannot compete with sun-cured legume hay, but it is an excellent source of vitamins E and K, both of which are essential in swine and cattle rations.

Water-Soluble Vitamins

Of the several water-soluble vitamins required by swine, riboflavin, pantothenic acid, and niacin are most likely to be critical under practical feeding conditions. Dehydrated alfalfa meal is an excellent source of the first two and a fair source of the third.

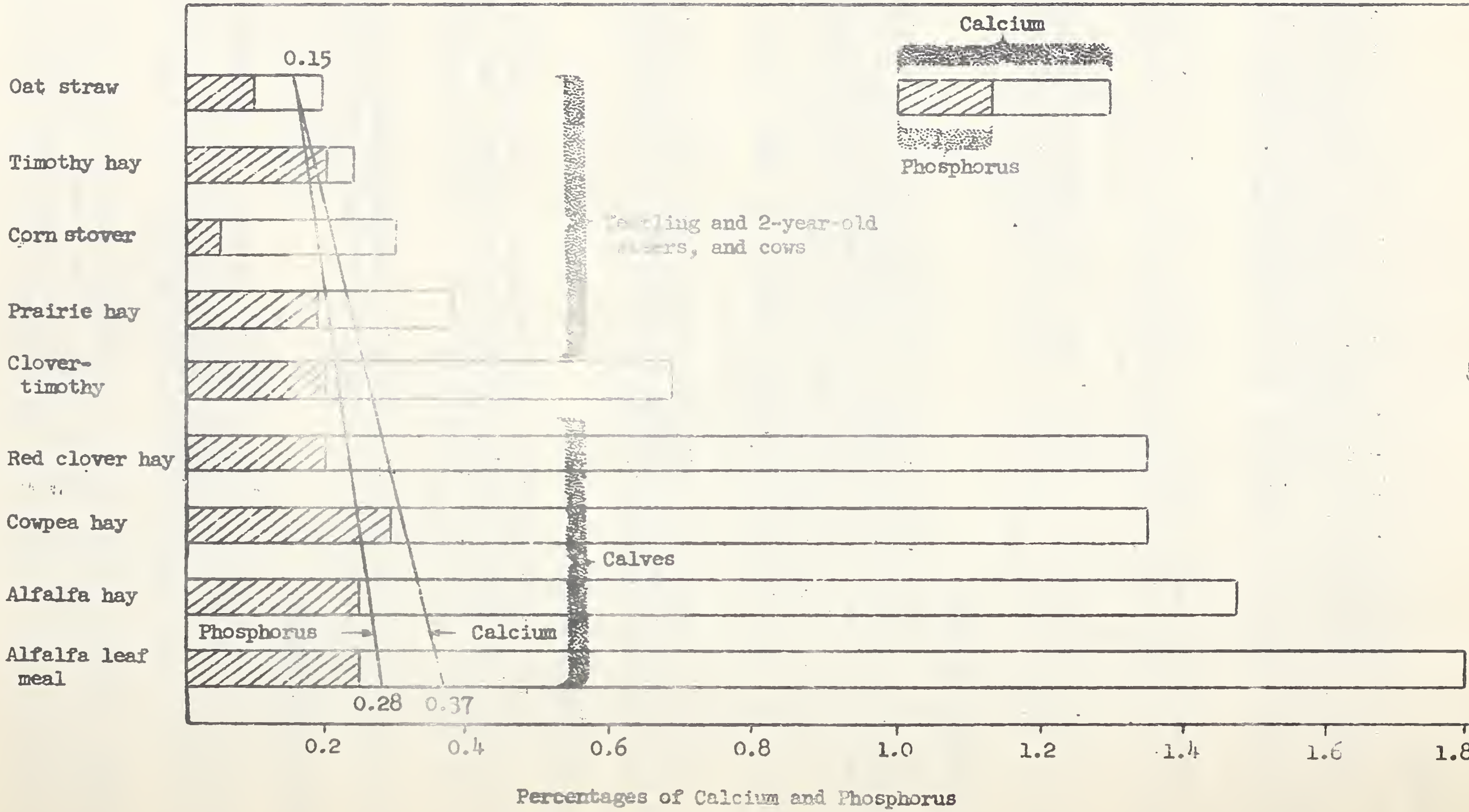
Cattle, because of the normal activity of microorganisms in the rumen, are adequately supplied with the water-soluble vitamins under practical conditions.

Unidentified Factors

It is when we come to consider the still unknown or unidentified nutritional factors that the story of alfalfa becomes most intriguing, because alfalfa has been shown to have important values in the feeding of poultry, swine, and cattle that cannot be explained in terms of any of the known nutrients.

Extensive studies with swine at the Illinois Station have demonstrated repeatedly that a ration of yellow corn, soybean meal, minerals, and vitamins A and D, plus six water-soluble vitamins, is significantly improved for sows during gestation and lactation by the addition of 10 percent of high quality

Calcium and Phosphorus Content of Common Forages
and Recommended Percentages of Calcium and
Phosphorus in Rations for Beef Cattle



alfalfa meal. Because a higher percentage of pigs was weaned from sows fed alfalfa meal, the Illinois workers have postulated a "survival factor" in alfalfa meal. Similar results have been reported from the Indiana and Wisconsin Stations.

As evidence of the recognized importance of alfalfa meal in swine rations, I have a recent letter from a member of the staff at Nebraska stating, "We routinely use 20 percent of dehydrated alfalfa meal in our gestation rations which are self fed. We also recommended that gestation rations hand fed to brood sows in dry lot contain a minimum of 15 percent high quality meal or dehydrated alfalfa meal." Similar recommendations are almost standard throughout the Middle West.

No doubt most of you are familiarwith the early work at the Ohio Station which showed that alfalfa ash was as valuable for steers, when fed at the rate of 2.8 ounces per head per day, as a complex mineral mixture fed at the rate of 3 ounces, and that it was almost as good as dehydrated alfalfa meal itself. The results of one such test follow:

Ohio Agricultural Experiment Station
Protein Supplements for Poor Quality Hay

625-pound steers were fed in lots of 10 from December to July (210 days). The average daily ration was 15 pounds of corn and cob meal, 2.2 pounds of poor quality hay, salt and a mixture of bone meal, limestone and salt, free choice, plus the supplements indicated.

Lot No.	1	3	4	5
Soybean meal	1.5 lb.	1.5 lb.	1.5 lb.	- -
Complex mineral	--	3 oz.	--	--
Alfalfa ash	--	--	2.8 oz.	--
Dehydrated alfalfa meal	--	--	--	3.5 lb.
Average daily gain	1.75 lb.	2.07 lb.	2.19 lb.	2.28 lb.
Dressing percentage	61.3	61.5	60.6	62.8

Digestion trials with steers showed that digestion of ground corn cobs was improved progressively by four increasing additions of alfalfa meal. A water extract of alfalfa meal or the ash of alfalfa meal gave similar results.

Workers at the Pennsylvania Station pointed out that the increase in apparent digestibility of dry matterand crude fiber could conceivably be of no benefit to the animal if at the same time there occurred an increase in methane production corresponding to the decrease in feed output. They therefore ran experiments with sheep in which they measured not only digestibility, as affected by alfalfa ash, but also the production of methane and of metabolizable energy.

With a ration containing about 40 percent ground corncobs, the apparent digestibility of crude fiber was significantly increased by the addition of 28 grams

of alfalfa ash per head per day. The net effect was an increase in the amount of feed energy available to the animal. The fact that the observed increase in methane production was due to increased fermentation in the rumen, lends support to the view that alfalfa ash furnishes inorganic nutrients that are essential for maximum activity of rumen microorganisms involved in roughage digestion.

Digestion experiments with sheep were conducted at the Oklahoma Station with rations containing 45 percent ground corncobs, 25 percent ground yellow corn, 20 percent corn gluten meal, 7 percent corn sirup, and 3 precent corn oil, plus calcium phosphate, potassium iodide, cobalt chloride and cod liver oil. In all experiments the addition of 35 grams of alfalfa ash per head per day improved the apparent digestibility of organic matter, particularly crude fiber. No combination of minerals made up to simulate alfalfa ash was as effective as the ash itself.

Recent tests at the Indiana Station have shown that the much publicized Purdue Cattle Supplement A is significantly improved by the addition of dehydrated alfalfa meal. The data from two of the Indiana experiments are summarized in the following tables:

Purdue Agricultural Experiment Station

Wintering Steers on Corncobs

First Experiment

550-pound steers, 8 per lot, wintered from November to April, 168 days, on corncobs plus supplements indicated:

lot no.	4	5 (pounds)	6
Daily feed per steer:			
Corncobs	16.0	15.0	14.0
Soybean meal	2.5	2.5	2.5
Molasses	1.0	1.0	1.0
Alfalfa meal	---	1.0	2.0
Minerals, free choice to all lots			
Average daily gain	1.01	1.14	1.28

Second Experiment

590-pound steers, wintered from November to May (198 days)

Lot No.	2	3 (pounds)	6
Daily feed per steer:			
Corncobs	14.70	14.64	14.65
Soybean meal	2.50	1.50	1.50
Molasses	1.00	1.00	1.00
Ground corn		.90	.65
Urea		.12	---
Alfalfa meal			2.00
Average daily gain	1.28	1.27	1.42

Dr. W. M. Beeson of Purdue has summarized findings at the Indiana Station as follows:

> "Dehydrated alfalfa meal contains some unknown factor or factors which improve the utilization of roughages and significantly increase the growth rate of steers. Feeding 0.5, 1.0 and 2.0 pounds of dehydrated alfalfa meal per steer daily has significantly increased gain and feed efficiency beyond any extra protein or energy that might be furnished by this small amount of alfalfa. It appears now that the new formula for 'Supplement A' will contain 14% dehydrated alfalfa meal."

Purdue Cattle Supplement A Formula
(With Dehydrated Alfalfa Meal)

Soybean meal	650.5 pounds
Molasses	140.0
Dehydrated alfalfa meal	140.0
Bone meal	52.0
Salt with cobalt	17.0
Vitamin A and D concentrate (10,000 A; 1250 D per gram)	0.5
	1000.0

In summary, dehydrated alfalfa meal is recognized as an important feed ingredient because of the high quality protein and the important minerals and vitamins it contains. Of special significance at the present time is the evidence accumulating from several sources that alfalfa also contains one or more unidentified factors that are essential for normal reproduction in swine and for rapid growth and high feed utilization in cattle, sheep, swine, and poultry. There would seem to be a considerable unexplored market potential for dehydrated alfalfa meal in the feeding of larger animals, particularly beef cattle.

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"Composition of Alfalfa--Its Relation to the Production of Improved Feeds"--- W. D. Maclay (Abstract)

Progress that has been made in research on other crops and the benefits that have accrued as a result of that progress are promoting appreciation of a need for a basic understanding of the nature of alfalfa to assist in improved production, processing and utilization. Examples of this type of approach which are receiving consideration include the breeding of sugar beets having improved processing qualities, study of the metabolism of the sugar beet to develop means of reducing sugar loss in stored beets through respiration, and the development of a broad basic knowledge of the chemical composition of the rice kernel along with its physical and biological properties to provide a rational basis for the proper handling and processing of that cereal.

Although much is already known about alfalfa there are many important questions that can be asked about it for which only vague or incomplete answers can be provided by our present knowledge. A few examples of the subjects pertaining to composition of alfalfa upon which more fundamental information is needed are: (1) The often postulated chick-growth factors mentioned by Dr. Almquist; (2) The unidentified "swine-survival-" and "cattle-growth-" or "cattle-digestion" factors discussed by Dr. Card: (3) Xanthophyll pigments, the practical importance of which Mr. Halloran discussed; (4) Other dietary factors which are deleterious, for example, the often discussed "chick-growth-inhibitor."

Proteins, carbohydrates, fats, hemicelluloses, lignin and minerals totaling about 82.75% of the dry weight of alfalfa are its major components. An additional 2.25% represents the portion of alfalfa which includes such substances as known vitamins, chlorophyll, stachydrin, the newly measured flavone tricin, and saponin. About 8 organic acids which have recently been tentatively

identified at the Western Regional Research Laboratory constitute another 6-9% bringing the total of measured constituents to about 91% to 94% of the dry weight of alfalfa.

Exploration by chromatographic techniques shows that at least another dozen components are present in alfalfa. May the "poultry-" and "animal-growth" factors, the existence of which is indicated, be among those unidentified components of alfalfa? If they are, can they be separated and characterized so that dehydrating and storage conditions can be defined to better preserve them? Secondly, are they genetically controlled? If so, can the plant breeder produce plants with higher concentrations of the beneficial ones and lower concentrations of the deleterious ones.

As this type of knowledge concerning alfalfa increases, the industry will progress to a better position to produce the quality of product is seeks to perfect and which the feed and feeder industries are most anxious to procure.

"Carotene Determination--Sources of Possible Error." (Abstract) -- C. R. Thompson.

When contrasted with the older method of analysis which depended upon liquid-phase separation, the chromatographic method now used for determining carotene represents a major advance. As it is presently practiced, however, the chromatographic method is not without fault. This is evidenced by incomplete uniformity in the results of collaborative assays performed in laboratories throughout the country on replicate alfalfa meal samples prepared and issued to participants under the plan sponsored by the American Dehydrators Association.

In the three years during which the collaborative assay program has been in effect, considerable progress has been made in discovering and overcoming obstacles to satisfactory application of the chromatographic method for determining carotene in alfalfa meal.

Some of the errors in application of the chromatographic method may be traced to inadequate or unsuitable laboratory facilities and some to exercise of insufficient skill on the part of operators. Specific examples of these error sources are: (1) faulty colorimeters; (2) evaporative loss of acetone during reflux digestion of sample. This can result in incomplete elution of carotene from the chromatographic column; (3) oxidation or isomeration of carotene during analytical manipulation; (4) evaporative loss of solvent in lower section of column due to excessive suction; (5) use of excess eluant on column leading to inclusion of other pigments in recovered carotene solutions. Much could be done to eliminate errors of the types mentioned by development and adoption of improved instructions for procedure. Noteably, however, inaccuracies can arise from non-uniformity in two important supplies used in the method, namely in the carotene used as a reference material in calibrating the colorimeter and in the magnesia used to form the adsorption column.

Pure carotene for use as a reference material cannot be purchased with the result that often operators having insufficient skill for the operation must attempt purification of the commercially available grade of the chemical.

The adsorptive properties of the magnesia used in the chromatographic column can vary to an extent sufficient to introduce serious analytical errors. The particular grade of magnesia recommended in the approved analytical procedure is manufactured by a West Coast firm and is presumably made in large batches. Variation in the activity of this material as it comes from the manufacturer has not been detected but the possibility of variation among different production batches should not be ignored. Loss or change in its adsorptive activity due to exposure to moisture or carbon dioxide can occur at any time after its manufacture. Analytical errors attributable to this cause are probably among the most serious and most frequently encountered. It is suggested that this type of error might be minimized if a central supply of the adsorbent having tested activity and packed in small sealed containers were made available to laboratories performing carotene determinations.

In the discussion that followed Dr. Thompson's remarks several suggestions were made regarding steps that might be taken to overcome difficulties caused by variation or change in the activity of magnesia. One such suggestion was that a standardized procedure might be devised for re-activating magnesia that had become altered during storage. Such a procedure would involve heating the magnesia to a specified temperature for a specified period of time. Another was that the performance of each new lot of magnesia received by a laboratory could be compared with that of the previous lot to find out whether suitable alterations in analytical procedure would be needed in order that correct results might be obtained with it.

Several of those present recommended that Mr. Larson, secretary of the American Dehydrators Association, investigate the possibility of acting upon Dr. Thompson's suggestion regarding procurement of a standardized supply of magnesia with the idea that if it proved feasible the Association would assume the duty of distributing sealed packages of the material to users. Mr. Larson signified that he would act upon the recommendation.

Alfalfa Processing

J. Fielder - Presiding

"Field Harvesting" (Abstract) -- Ray E. Bert

Field harvesting comprises preparation of the crop and placing it in transport to the satisfaction of the farmer and the processor. From the farmer's viewpoint it is desirable that fields be mowed cleanly and that passage of the harvesting equipment does not produce rutted wheel tracks in the ground. The processor wants cleanly chopped alfalfa that can be dehydrated without excessive loss of carotene and he wants it to be gathered and delivered to him with a minimum loss of leaves. The dehydrator also wants to receive chopped alfalfa at a uniform rate that matches his optimum rate of production.

In order to perform his operations ecomonically and to the satisfaction of the farmer and the dehydrator, the harvester must use suitable equipment and have the necessary facilities to keep it operating economically and at top efficiency.

Wheel ruts can be avoided by offsetting front and rear wheels on harvesting equipment so that they do not follow one another in the same track. Use of tires with broad treads also helps to prevent ruts. This is especially important on soft or wet fields.

Clean mowing can only be accomplished with equipment of good design. In the midwest summer rains cause alfalfa to lodge thus creating a need for special measures to prevent ragged mowing. One device intended to assist in clean mowing is the extra large and long divider. A special feature of one such divider is a slot which accommodates the end of the sickle bar. This permits clean cutting up to the face of the divider and prevents leaving an unmowed strip at the edge of the swath.

Sharp chopper blades are essential to the production of cleanly chopped alfalfa. Use of an open-type conveyer that permits dirt and sand to drop out of the alfalfa before it reaches the chopper protects the chopper blades, lowers maintenance costs and assists in production of a cleanly chopped product.

Loss of leaves can occur when chopped alfalfa is blown into the trailers that haul it to the dehydrator unless the transfer equipment is properly designed. At least one operator uses canvas covers on his trailers to prevent loss of leaves.

Breakdowns of harvesting equipment in the field can, unless they are quickly repaired, be costly, both to the harvesting operation through lost time and to the dehydrating operation either through slowdown or interruption of production schedules. For this reason field trailers carrying spare parts, tools and welding equipment are profitable additions to the other items of harvesting equipment.

The use of tapered-lock washers in securing pulleys, sprockets, gears and other members to shafts has been found to greatly simplify and speed up assembly and disassembly of equipment parts that must be replaced or repaired in the field.

Mr. Bert introduced the subject of harvesting and hauling costs in his paper. This led to an impromptu discussion of costs in general. However, differences in accounting methods as well as difficulties in weighing the influences of special circumstances upon specific unit costs prevented formulation of strictly comparable cost estimates.

Out-of-pocket production costs per ton of meal exclusive of depreciation, overhead or cost of fresh alfalfa as given by one operator for his 1952 season were:

	Harvesting	Hauling	Dehydrating	Total
Labor	$1.89	$ 1.54	$ 1.94	$ 5.37
Gasoline and Oil	.61	.38	.11	1.10
Repairs	1.41	.80	.90	3.11
Fuel			2.32	2.32
Power			1.58	1.58
Bagging and Warehousing			1.61	1.61
	$3.91	$ 2.72	$ 8.46	$15.09

Illustrative of the way in which the variables mentioned earlier influence computations such as these is the fact that harvesting costs were variously estimated within the range from $2.00 to $6.00 per ton of meal.

"The Dehydrator" (Abstract) -- V. C. Britton

In its technical operations the V. C. Britton Company has attempted to place emphasis upon maintenance of uniform high quality in its product. To this end it has adopted the practice of blending.

Meal at as near 10% of moisture as possible is currently stored in three types of warehouses; (1) uncooled warehouse; (2) warehouse equipped with evaporative coolers; and (3) refrigerated warehouse maintained at 30-32° F. Since carotene losses are higher during storage in tight stacks, all meal is stored on pallets.

After 5-6 months of storage under refrigeration at about 32°F. meal retains 70% to 80% of its initial carotene.

Trials of an antioxidant, Santoquin (6-ethoxy-2,2,4-trimethyl-1,2-dihydroquinoline) have shown that this substance can prevent about 50% of the carotene loss that would otherwise occur. Meal treated with the antioxidant also retains its color better during storage than does untreated meal.

All meal produced by the V. C. Britton Company is treated with rice oil to reduce dustiness.

Improvements in alfalfa varieties and strains that have come about through scientific breeding programs are convincing examples of the practical values research can contribute to the alfalfa industry. As examples they afford compelling argument for continued and augmented support for further research.

He concluded by stating that the dehydrators' immediate customers, the feed manufacturers, need and want a steady supply of uniformly high quality of meal. The prosperity of both dehydrators and feed manufacturers would be enhanced if such a supply could be made available at steady prices. Furtherance of sound trade practices such as adherence to a system of stabilized guarantees is another way in which dehydrators can better their own lot.

Mr. Britton briefly told of some of the advantages of membership in the American Dehydrators Association. He stated that it was to the dehydrators interest to actively support their Association since it represents them, acts as a clearing house for ideas, stimulates and supports research, all to better advantage to the industry, than its members could accomplish were they to act independently.

"Oiling Alfalfa Meal" (Abstract) -- G. R. Van Atta

Within the last few years development work in the application of oil solutions of carotene antioxidants has drawn attention to the practicability of dust control through addition of small quantities of oil to alfalfa meal. As a result a growing number of operators are producing oiled meal.

Points to be considered in connection with oiling include: (1) choice of oil; (2) quantity of oil needed and its cost; (3) stages in meal manufacture at which oil can be added; and (4) equipment required for oiling.

The principal physical characteristic of a satisfactory oil is free fluidity at the temperature of the meal during mixing. Common oils such as cottonseed, rice, soybean and fish oils have been used. Presumably oils that are semi-solid at ordinary temperatures might be applied in the molten state. However, if they become partially solidified in the early stages of mixing, mechanical difficulties might ensue. Studies on this subject have been initiated at the Western Regional Research Laboratory. Oils need not be refined but they should be free of sediment that could interfere with smooth operation of whatever devices are used to meter and apply them. Highly unsaturated oils, e.g, linseed and some fish oils might accentuate overheating in storage caused by too much moisture in the meal. Mineral oils interfere with carotene assimilation and acidulated s eed-oil soapstocks cause meal discoloration.

For controlling dust current practice is to add about 7-1/2 to 10 pounds of oil per ton of bagged meal and about 10 to 25 pounds per ton of bulk meal. At these levels oils do not affect carotene stability. Net material cost for oiling could be regarded as the difference between the cost of the oil used and the price of the weight of meal which it would replace in the finished product.

In a dehydrating plant oil may be applied either before or after grinding. Addition before grinding affords several advantages over application after grinding. The first is that oil added to the chopped hay soon after it leaves the drier helps to prevent escape of dust at cyclone separators and at all further points in the system. An important further advantage of oiling before grinding is that thorough mixing is then assured by hammer milling alone, whereas a separate mixer must be provided if oil is applied to the finished meal.

A unit that has proved satisfactory for metering and delivering oil to dried alfalfa before it is ground comprises an oil-filter and a gear pump, the pump being driven by a remote-electronically-controlled variable-speed motor. Because the quantity of oil it is necessary to pump per hour to match even

high rates of meal production is quite small, an accurate metering pump of very s mall capacity is used in the unit so that dosage can be regulated properly. Illustrative of the size of the pump is the fact that when driven at 273 r.p.m. it delivers one gallon per hour.

Oil is carried from the pump through a 1/4" copper tube ending just inside the wall of a pneumatic duct which conveys chopped hay away from the drier. No nozzle or spray head is needed since the fast moving air in the duct instantaneously breaks the oil stream into spray that quickly mixes with the hay. Later, very thorough mixing occurs in the hammer mill. Choosing the point where the oil enters the conveying system is largely a matter for individual judgement.

If meal is oiled after it is ground, a continuous- or sem-continuous mixer is needed in addition to an oil metering device.

<u>"Pelleting Alfalfa Meal"</u> (Abstract)-- A.Alessio

Comparison of costs of manufacturing, handling, storing and shipment of pellets with the corresponding items pertaining to loose meal is a subject worth scrutiny by the alfalfa dehydrator. The pelleting operation itself costs in the neighborhood of $3.00 per ton of meal. Variations in this item are effected primarily by such factors as the percentage of fiber in the meal and the amounts of abrasion caused by differing amounts of sand or dirt in the meal. The life of pellet mill dies may vary between 2700 tons and 20,000 tons of meal depending upon the dirt or sand content of the meal. Since pelleting is an automatic operation it usually requires no additional plant labor.

Packing labor for loose meal may cost from $2.00 to $2.50 per ton whereas bulk handling possible with pellets costs only a few cents per ton. A 23" x 40" bag of 3/16" pellets holds as much meal as a 63" x 40" bag of loose meal. This difference in bulk represents a difference of $2.00 per ton in bag costs. Due to their smaller bulk pellets require only half as much storage space as do like weights of loose meal.

Since tote boxes can be used for pellets additional savings in blending costs can be had with pelleted as opposed to loose meal.

Absence of dust in handling pelleted meal is an important advantage afforded by this form of product and one which cannot be readily reckoned in terms of cost.

Present day pellet mills are of the roller rather than the screw type and do not scorch the meal as the early screw extruders did. Steam is not essential to production but its use contributes to economy and each of operation. A pellet cooler is an indispensable part of the equipment needed for pellet manufacture. Besides lowering their temperature the cooling operation allows the pellets to lose moisture to the extent that they will not mold in storage.

A new free flowing, non-dusty powder made by regrinding and sifting pelleted alfalfa meal is beginning to attract attention. In the regrinding process about 12% of fines are produced that could be recycled through the pellet mill and regrinder or "crumbler". However, at the present time these fines have ready sale as a high-nutrient alfalfa product. A "crumbling" and sifting unit capable of handling 6 tons an hour costs about $15,000.

Discussion.

The principal topic concerned the current status of toxicity studies on the carotene antioxidants, "Santoquin" (6-ethoxy-2,2,4-trimethyl-1,2-dihydroquinoline) and 2,5-ditertiary butyl hydroquinone, found effective for alfalfa meal at the Western Regional Research Laboratory. Dr. Maclay pointed out the great amount of work such studies entail. This includes determining any effects various levels of the chemicals may have upon growth and reproduction of different species of animals. It also involves pathological examination and chemical assay of various organs and tissues to determine if feeding the antioxidants produces any deleterious effects on the animals or results in retention in their bodies of residual amounts of the chemicals. Studies involving the rat, guinea pig and rabbit are bing carried out at the Western Regional Research Laboratory. Those involving chickens are in progress at Colorado A and M College (supported by an ADA research grant) and at the Southwest Poultry Experiment Station, U. S. Department of Agriculture, Glendale, Arizona; and those on pigs and calves at the University of Illinois (also supported by an ADA research grant). The greater proportion of these feeding experiments should be concluded by early Fall of this year. It is hoped that the growth and reproduction data from these, along with those from the pathological and chemical assay of various organs and tissues will provide the information essential for presentation to the federal Food and Drug administration for its consideration as to the safety of these chemicals for the proposed use.

Mr. Lloyd Larson, Secretary-Treasurer, American Dehydrators Association, concluded the discussion with a brief resume of the Association's objectives and its research program. He also briefly reviewed the several conferences, meetings and informational releases in which the office of the Association has participated this year and enumerated like activities scheduled for the near future.